

Historic, archived document

Do not assume content reflects current scientific knowledge, policies, or practices.

9
25041

CORE LIST

151, 12p., map. 1973

U. S. DEPT. OF AGRICULTURE
NATIONAL AGRICULTURAL LIBRARY
RECEIVED

SEP 25 1973

PROCUREMENT SECTION
CURRENT SERIAL RECORDS

2501
PAUL H. LANE,
RICHARD O. WOODFIN, JR.
JOHN W. HENLEY
MARLIN E. PLANK

pacific northwest
forest and range experiment station
u.s. department of agriculture forest service
portland, oregon

New Timber Cruising Grades for Coast Douglas-fir

Apiculatus menziesii

ABSTRACT

New log grades for cruising coast Douglas-fir have been developed and tested. They are for application to standing timber and provide an accurate estimate of lumber and veneer yields and timber values.

KEYWORDS: Log grade, timber cruising, forest appraisal, coast Douglas-fir, *Pseudotsuga menziesii*, lumber yield, veneer yield.

CONTENTS

	Page
INTRODUCTION	1
Coast Douglas-fir Timber Resource	1
Grading Timber for Appraisal	1
STUDY METHODS	2
NEW GRADING RULES	3
General Grading Specifications	3
Definitions of Log Grading Characteristics	3
Application of Grades	4
Summary of Specifications	4
HOW THE GRADES PERFORM	4
Field Application Trials	6
End Product Yields and Log Values	6
SUMMARY AND CONCLUSIONS	6
APPENDIX	10
Lumber and Veneer Prices	10

ACKNOWLEDGMENTS

The grading system described is based on a series of studies carried out by the Pacific Northwest Forest and Range Experiment Station in cooperation with other Government Agencies and the forest products industry. Particular credit is due the following organizations and people:

U. S. DEPARTMENT OF AGRICULTURE, FOREST SERVICE

Pacific Northwest Forest and Range Experiment Station--staff personnel of the Timber Quality Research for Western Softwoods Project who assisted with data collection, analysis, and compilation, Thomas D. Fahey, M. Wallace Burck, David C. Carpenter, Donald C. Martin, Mildred P. Reeder, and Juliet G. Bentley.

Pacific Northwest and California Regions--aid in data collection and field demonstrations of the new grades.

U. S. DEPARTMENT OF THE INTERIOR

Bureau of Land Management--Portland Technical Service Center, Oregon State Office, and California State Office for aid in data collection and field demonstrations.

Bureau of Indian Affairs--collection of data.

FOREST PRODUCTS COMPANIES--particularly those companies who assisted in logging the study material and made their facilities available for the processing of logs into lumber and veneer.

FOREST INDUSTRIES ASSOCIATIONS who provided grading supervisors during sawing and peeling operations--American Plywood Association, Timber Engineering Co., Western Wood Products Association, Pacific Lumber Inspection Bureau, and West Coast Lumber Inspection Bureau.

INTRODUCTION

The Pacific Northwest Forest and Range Experiment Station has developed a new system for grading old-growth, coast-type, Douglas-fir sawtimber.^{1/} This paper describes the new grading specifications for timber cruisers and timber appraisers and suggests procedures for field application. Detailed information in the form of lumber and veneer yield performance tables and other statistical data for the grades is beyond the scope of this report but will be published later by the Station. Included in the report, however, is a brief description of how the system was developed, the results of field application trials, and some average yield data for lumber and veneer to illustrate how the grades perform in predicting end product yields and timber value.

COAST DOUGLAS-FIR TIMBER RESOURCE

Coast-type Douglas-fir is one of the most important tree species in the United States in terms of timber cut for the production of lumber, veneer, and other end products. About 10 billion board feet of coast Douglas-fir is harvested annually in western Washington, Oregon, and northern California. In 1968, the stumpage value of this annual cut was estimated to be in excess of \$550 million.

About 30 percent of this commercial Douglas-fir timber is cut from National Forests and other Federal lands and must be appraised by these public agencies when it is offered for sale.

GRADING TIMBER FOR APPRAISAL

An essential part of the timber sale process on public lands is estimation of the sales realization value; i.e., the dollar value of the timber on a given sale area in terms of the lumber, veneer, or other end products that could be produced. This is normally done by cruising all, or a sample of the trees on the sale area to obtain an estimate of the timber volume and quality (dollar value). Timber volume is usually expressed in board feet and is obtained from the cruise measurements of trees on the sale tract. Quality is determined by applying an adequate grading system to the cruised trees as described by Lane.^{2/}

A grading system for timber appraisal should provide clear, easily applied specifications that will sort or rank trees according to their value for producing given end products. The system should also provide reasonably accurate estimates of the quantity and dollar value of specific end products for a group of trees. Adequate timber grading systems for a given species or group of species can be developed best by analytical studies of the timber characteristics and their relationship to end product yields and values.

^{1/} Old growth is defined as trees generally more than 100 years old. Coast-type (or "west-side") Douglas-fir *Pseudotsuga menziesii* (Mirb.) Franco, variety *menziesii*, is the botanical variety growing west of the crest of the Cascade Range in Washington and Oregon and the Sierra Nevada Range in northern California. Sawtimber is merchantable trees 11 inches and larger in diameter at breast height (d.b.h.).

^{2/} Paul H. Lane. Evaluating log and tree quality for wood products. Forest Prod. J. 13(3): 89-93, 1963.

The grading systems presently used by public agencies in appraising coast Douglas-fir timber were developed a number of years ago and do not adequately reflect present timber utilization and manufacturing practices, nor are they entirely satisfactory from a standpoint of field application.

To provide an up-to-date analytical grading system for coast Douglas-fir, the Pacific Northwest Forest and Range Experiment Station studied the quality and end product yields of an extensive sample of commercial old-growth sawtimber. This research resulted in new grading specifications described in this paper.

STUDY METHODS

The new grading system was developed by study of the quality characteristics and yields of lumber and veneer from more than 1,000 mature Douglas-fir trees selected from typical commercial sawtimber stands throughout the coast Douglas-fir region. The study trees were selected from approximately 100 sample areas in California, Oregon, and Washington. About three-quarters of these trees were sawn at 10 sawmills, and the remainder were processed at 10 veneer plants. The general sample areas and mill locations are shown in figure 1.

Study trees were selected to be as representative as possible of coast-type commercial sawtimber and to sample the full range of timber size and quality. Bucking and sawing of logs and peeling of veneer blocks was done according to the normal practice at each study mill. All the study logs were scaled by Federal agency check scalers or scaling supervisors. The lumber was graded by, or under direct supervision of, a quality supervisor of the Western Wood Products Association, West Coast Lumber Inspection



Figure 1.—Approximate location of the timber sample areas (●), study sawmills (◐), and veneer plants (◑).

Bureau, or the Pacific Lumber Inspection Bureau. All veneer was graded by, or under the supervision of, the American Plywood Association or the Timber Engineering Company.

The study yielded a total of about 2.7 million board feet of lumber and 1.9 million square feet (3/8-inch basis) of veneer.

Detailed information was obtained on the quality characteristics and accompanying yield of lumber or veneer for each study tree and log. The relationship of log and tree characteristics to lumber and veneer yields was then analyzed by multiple regression and other statistical techniques, to develop trial grading specifications. Many trial specifications were tested until a final set was developed.

In developing the specifications, the yield data from three of the 10 lumber and veneer plants were withheld from the analyses for testing the trial specifications. This provided a data base on which to test specifications that were not part of development data.

In selecting the final specifications, consideration was given to the ease and uniformity of application by cruisers as well as the performance of the specifications as predictors of timber value.

NEW GRADING RULES

New grading rules and specifications were developed for estimating the dollar value of individual tracts of old-growth coast Douglas-fir sawtimber in terms of lumber and veneer yields. They are intended for use on live standing timber. They can also be applied to recently killed or blown down timber that has not deteriorated to the point that it is difficult to apply the grading specifications properly or that the normal product yields would be materially affected.

GENERAL GRADING SPECIFICATIONS

1. The grades are intended for 16-foot log^{3/} lengths as commonly cruised in standing trees. If the cruise log length includes trim allowance, the specifications must be applied to the entire length.
2. The grades are not intended for application to cull logs (logs with more than a two-thirds cruise volume deduction).
3. Although log diameter is not a specific grading criterion, the effect of grade

^{3/} The term "log" refers to designated sections of standing trees.

and size of log on value and product recovery will be reflected in performance tables to be published.

4. Most of the grading specifications are applied by log "faces." A log face is one-quarter of the log circumference for the full length of the log.
5. Logs that meet specifications for Grades I, II, or III must be lowered one grade when adjacent to a cull log.

DEFINITIONS OF LOG GRADING CHARACTERISTICS^{4/}

1. *Knots* refer to sound, live, or dead limbs or limb stubs outside of knot clusters. Knot diameter is measured at the log surface, inside the bark but outside the limb collar or swelling that may be present.
2. *Knot indicators* are bark distortions which indicate the presence of underlying knots. Usually there is a small hole or depression in the center of the distortion. Indicator size is determined by the vertical diameter of the depression.
3. *Knot clusters* are three or more sound limbs or stubs, 1 inch or larger, in an inseparable group. The size of individual knots in a cluster is not considered.
4. *Indicator clusters* are three or more knot indicators, usually well defined by a distorted bark pattern and surface rise.
5. *Scars* are breaks in the normal bark pattern caused by injuries from such things as fire, logging, frost, and lightning. They may be completely overgrown with callous tissue (old injuries), partially overgrown, or

^{4/} For additional definitions and descriptions, refer to "Log Diagramming Guide for Western Softwood" by George H. Jackson, John W. Henley, and Willard L. Jackson. USDA Forest Service, Pacific Northwest Forest and Range Experiment Station, Portland, Oregon, 32 p., illus., 1963.

open (of recent origin). Their condition, location, and size determine whether they are *degrading* and therefore considered in the log grading specifications or *superficial* and disregarded.

(a) *Degrading scars*. A scar is considered to be degrading when the underlying wood is decayed, excessively pitchy, severely checked, or otherwise injured to the extent that lumber or veneer recovery would be affected.

(b) *Superficial scars*. A superficial scar is a shallow, open, and sound injury of relatively recent origin that, in the judgment of the cruiser, will not affect lumber or veneer recovery and therefore is disregarded. Small scars--6 by 6 inches or less--whether open or overgrown, are also considered to be superficial *providing they do not contain rot or are not located in the lower 8 feet of the butt log* (see scar specifications for Grades I and II).

6. *Conks* are the fruiting bodies of fungi and indicate the presence of interior rot.
7. *Cankers* are lesions characterized by distorted bark, callous tissue, and pitch flow. Common causes are mistletoe and rusts.
8. *Rotten knots* are live or dead limbs or stubs showing rot. Rotten or "punky" knots are treated the same as conks.
9. *Sound burls* are round or elliptical woody growths that protrude abruptly from the log surface with no evidence of decay or pitch.
10. *Unsound burls* are characterized by evidence of decay or heavy pitch or both.
11. *Bumps and bulges* are bark-covered swellings on the log surface that do not conform to the normal taper or normal butt swell.

12. *Epicormic branches* are small, sprout-type limbs that originate from dormant or adventitious buds, usually a half inch or less in diameter.
13. *Holes* are the result of bird peckings or insect activity into the cambium.

APPLICATION OF GRADES

Cruisers (log graders) usually develop their own procedures for applying grading rules. The following are suggested steps:

1. Size up each log with respect to knots, determining either the poorest (shallow) or best (clearest) side.
2. Establish log grading faces based on the presence and character of any knots or indicators. Once the grading faces on a log are established, they cannot be shifted. Exception: see specifications for burls.
3. Apply knot or indicator specifications to determine preliminary grade of log; then apply other grading criteria such as scars, conks, etc., to establish final grade. For example, if the log is knot free, it is a potential Grade I. The grader would then look for other limiting characteristics to establish the final grade.

SUMMARY OF SPECIFICATIONS

The grading specifications are summarized in table 1. A convenient pocket size summary of the grades on waterproof paper for field use is also available from the Pacific Northwest Forest and Range Experiment Station.

HOW THE GRADES PERFORM

The performance of the new Douglas-fir grades can be measured by how well they can be applied in the field by timber cruisers and by their ability to predict timber values and product yields.

Table 1.—A summary of the new timber cruising grades for coast Douglas-fir

Log characteristic	Grade I ^{1/}	Grade II ^{1/}	Grade III ^{1/}	Grade IV
Knot (sound)	One allowed if 1 inch or less or one larger than 1 inch if within 6 inches of log end.	None allowed on two faces. Knots larger than 2 inches must be confined to upper or lower half of one face.	Knots (sound or rotten) larger than 3 inches must be confined to one face.	Any merchantable log not meeting requirements for Grade III.
Rotten knot	None allowed.	None allowed unless log is otherwise Grade I.		
Knot indicator	If larger than 1 inch, must be confined to no more than two faces.	No requirements.		
Knot cluster	None allowed.	One if confined to one face.	Any number if confined to no more than two faces.	
Indicator cluster	One allowed if confined to one face.	No requirements.		
Degrading scar	None allowed from ground line to 8 feet. Above 8 feet: No limit for <u>sound</u> scars 6 inches x 6 inches or smaller; larger <u>sound</u> scars must be confined to either one face or not more than two faces in any one-fourth of log length. No rotten scars allowed.	All scars having rot must be confined to one face.	No requirements.	
Sound burl ^{2/}	Disregard burls if less than 6 inches in diameter.			
	If larger than 6-inch diameter, must be confined to one face.	All larger than 6-inch diameter must be confined to three faces.		
Conk, canker, and unsound burl	None allowed.	None allowed unless log is otherwise Grade I.	No requirements	
Bump and bulge	None 6 inches x 6 inches or larger allowed from ground line to 8 feet. No requirements above 8 feet.	No requirements.		
Epicormic branches and holes	Must be confined to one face.			

^{1/} A log meeting specifications for either Grade I, II, or III is lowered one grade if adjacent to a cull log.

^{2/} When burls are considered, log faces can be shifted from the faces initially established for knots or other characteristics.

Extensive field application trials of the grades have been made by many public agency timber cruisers. The grades were applied to all of the saw logs (5, 138) and veneer logs (1, 484) produced from the study trees to evaluate yield and value predictions.

FIELD APPLICATION TRIALS

More than 40 timber cruisers of the U. S. Forest Service and Bureau of Land Management in Oregon and California participated in field trials and applied the new log grades to trees under a variety of stand conditions. The specifications and their application have also been discussed with several hundred representatives of industry in a series of public meetings in California, Oregon, and Washington.

The application trials and public meetings resulted in overwhelming support for the adoption of the grades in timber sale cruising. Some of the advantages of the grades expressed by the cruisers included: (1) increased accuracy and consistency of grading, (2) ease of learning and understanding the specifications, and (3) uniformity of grading among cruisers.

END PRODUCT YIELDS AND LOG VALUES

The average lumber and veneer yields by these new grades for all the study logs are shown in figures 2 through 7. Figure 2 shows a progressive and significant decrease in the yield of the Select grades of lumber from log Grades I to IV and conversely, an increase in the yield of the Utility and Economy lumber grades. A similar yield pattern for veneer is illustrated in figure 3. Figures 4 and 5 illustrate how the log grades stratify the dollar value of coast

Douglas-fir saw logs by grade and diameter. These value curves were developed by least squares regressions using dollars per thousand board feet, Scribner net log scale (figure 4), and dollars per thousand board feet, lumber tally, as dependent variables and log diameter as the independent variable (figure 5). Similar value curves for veneer logs are shown in figures 6 and 7. Representative lumber and veneer prices used in these analyses are shown in tables 2, 3, and 4 in the appendix.

SUMMARY AND CONCLUSIONS

The coast Douglas-fir grades described in this report have received extensive field application trials, and their performance in predicting the value of standing timber has been evaluated by key timber appraisal people in public agencies and industry. The trials demonstrated that these grades offer a number of advantages over grading systems presently available for coast Douglas-fir. Some of the desirable features of these new grades are that they:

1. Are analytical grades based on an extensive sample of timber and manufacturing plants, representative of public timber resource and industry practice throughout the coast Douglas-fir region.
2. Provide relatively accurate estimates of lumber and veneer yields and timber values.
3. Provide significant differences in product yield volumes and value among the four log grade classifications.
4. Have specifications that are easily understood and applied by cruisers.
5. Are applicable throughout the coast Douglas-fir region.

The obvious and demonstrable advantages of these new grades suggest their adoption for appraising the end product of coast Douglas-fir timber.

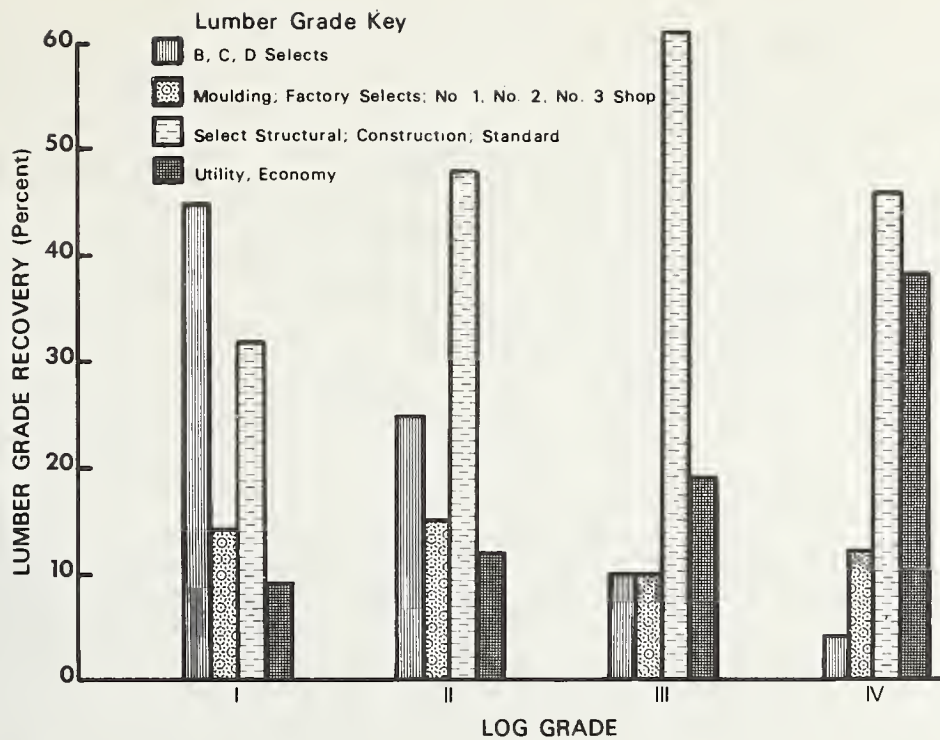


Figure 2.—Average coast Douglas-fir lumber recovery by lumber grade groups and by log grade. Basis: 558 Grade I logs; 1,049 Grade II logs; 2,310 Grade III logs; 1,221 Grade IV logs.

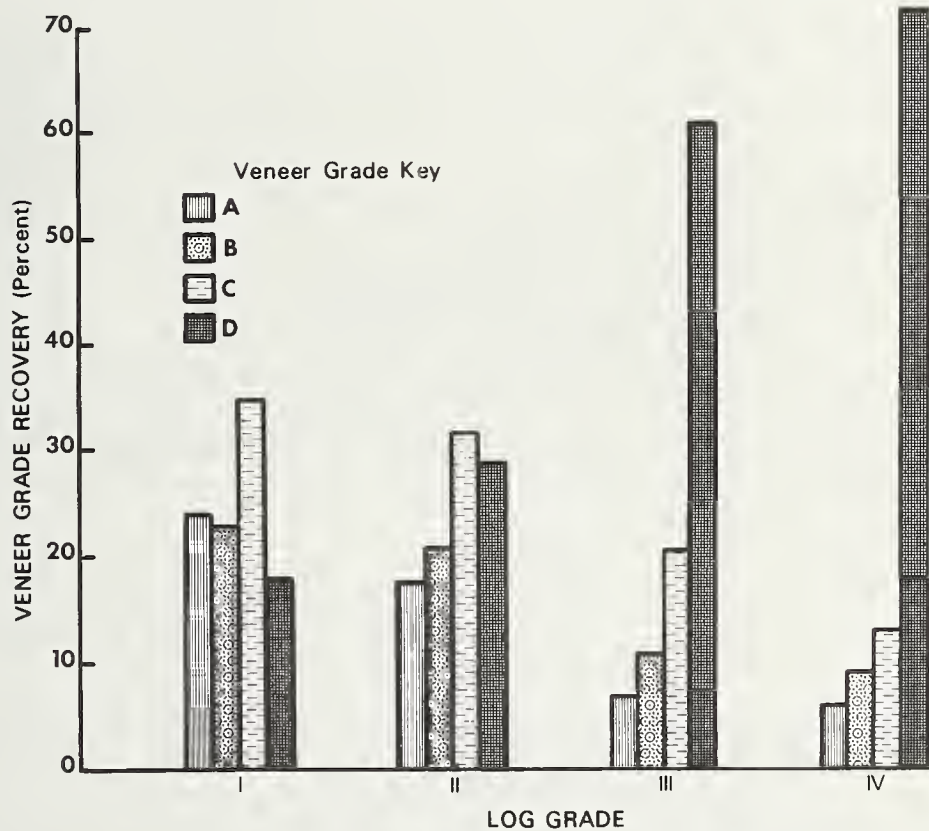


Figure 3.—Average coast Douglas-fir veneer recovery by veneer and log grades. Basis: 207 Grade I logs; 371 Grade II logs; 563 Grade III logs; 343 Grade IV logs.

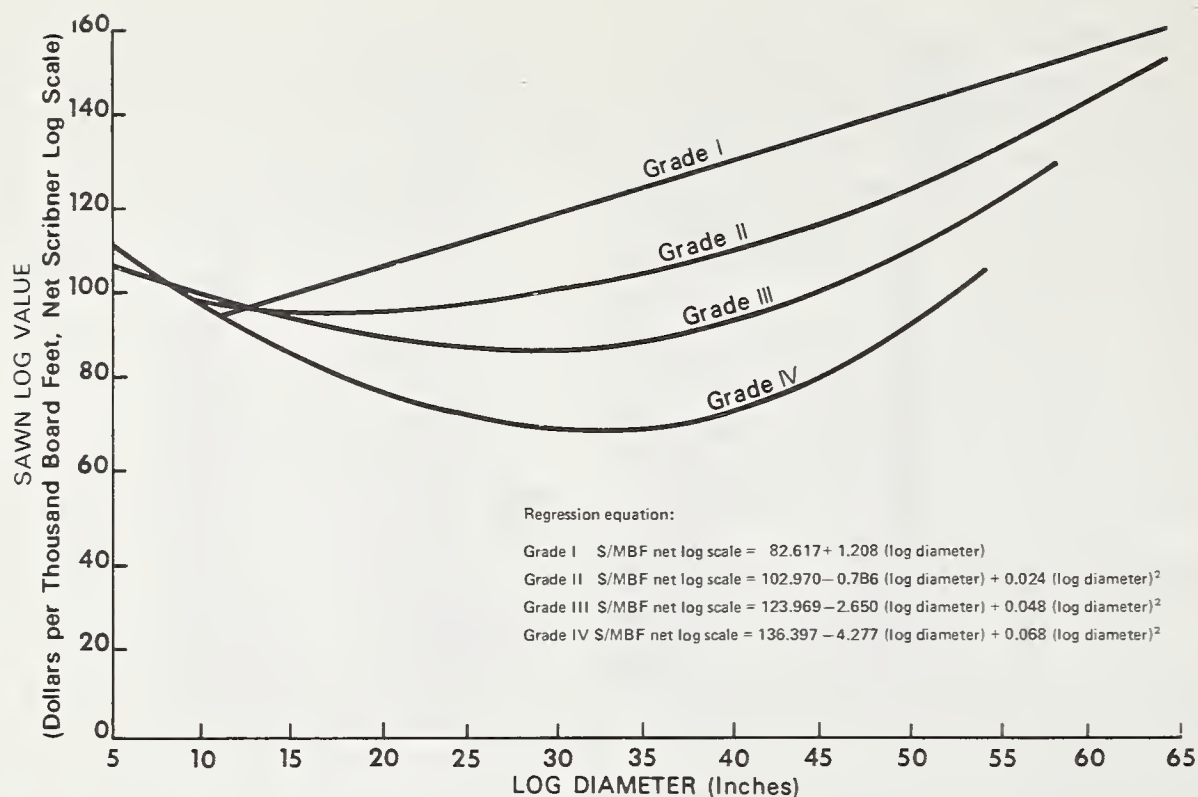


Figure 4.—Average value (dollars per thousand board feet, net log scale) of coast Douglas-fir saw logs by grade and diameter. Basis: 558 Grade I logs; 1,049 Grade II logs; 2,310 Grade III logs; 1,221 Grade IV logs. For lumber price base, see table 2 in the appendix.

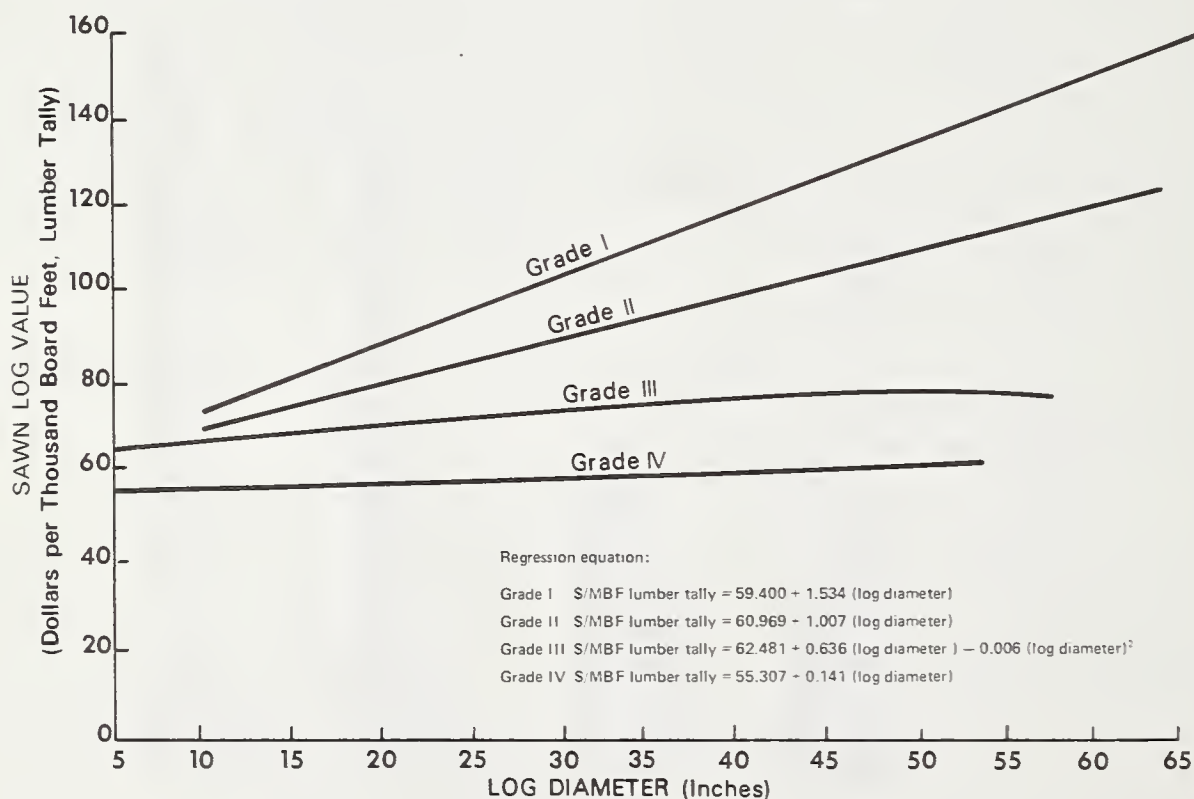


Figure 5.—Average value (dollars per thousand board feet, lumber tally) of coast Douglas-fir saw logs by grade and diameter. Basis: 558 Grade I logs; 1,049 Grade II logs; 2,310 Grade III logs; 1,221 Grade IV logs. For lumber price base, see table 2 in the appendix.

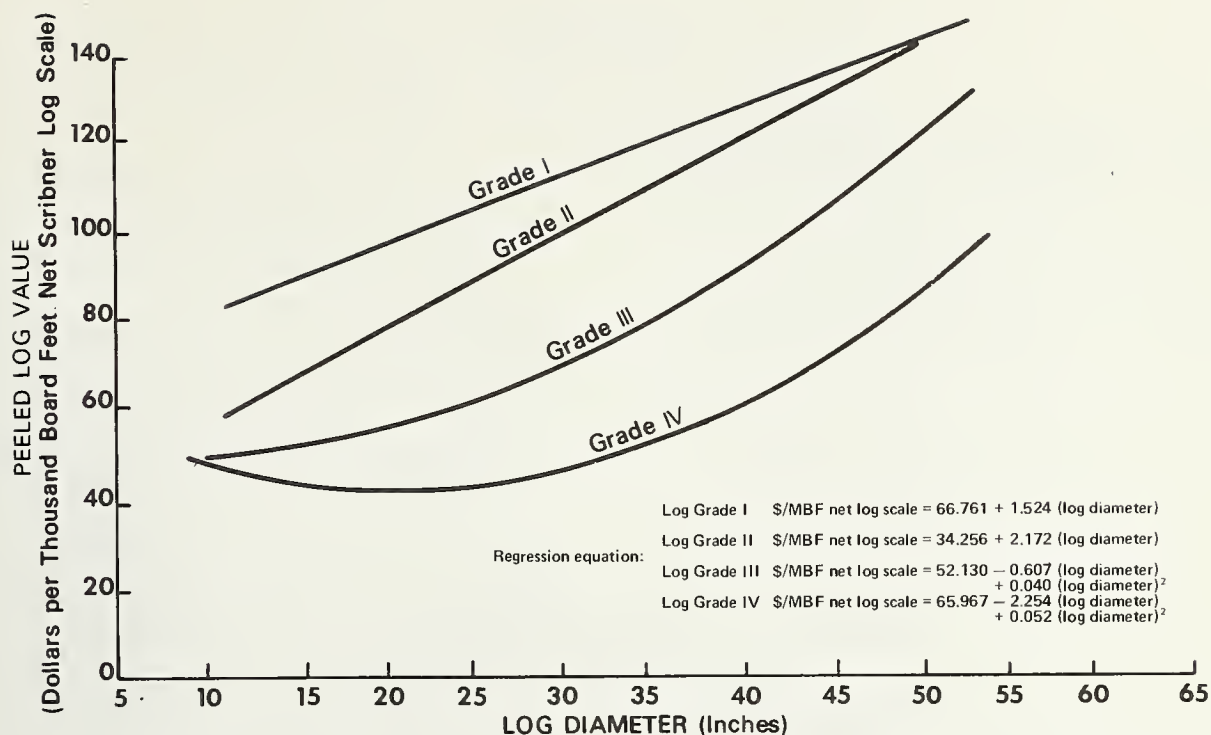


Figure 6.—Average value (dollars per thousand board feet, net log scale) of coast Douglas-fir veneer logs by grade and diameter. Basis: 207 Grade I logs; 371 Grade II logs; 563 Grade III logs; 343 Grade IV logs. For veneer price base, see table 3 in the appendix.

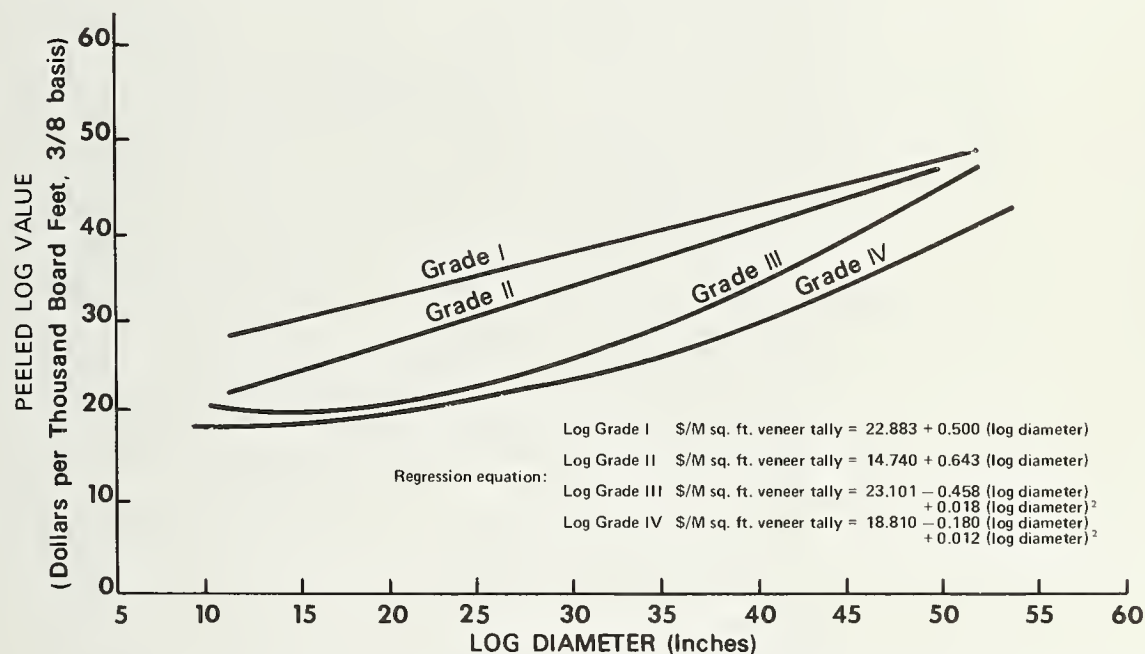


Figure 7.—Average value (dollars per thousand square feet, 3/8-inch basis) of coast Douglas-fir veneer logs by grade and diameter. Basis: 207 Grade I logs; 371 Grade II logs; 563 Grade III logs; 343 Grade IV logs. For veneer price base, see table 3 in the appendix.

APPENDIX

LUMBER AND VENEER PRICES

Prices were applied to the various grades and sizes of lumber and veneer produced from the study logs to determine log values, to develop the grading specifications, and to test the performance of the log grades. The prices used were judged to be representative of industry experience at the time of the analyses. Lumber prices used were for 1963 and

were obtained from various sources including "Random Lengths Weekly Lumber Price Guide," "Crow's Weekly Price Reporter," a number of private companies, and several government agencies. The veneer prices were developed from information provided by the American Plywood Association for calendar year 1965.

Lumber prices are shown in tables 2 and 3; veneer prices, in table 4.

Table 2.—Representative 1963 prices for coast Douglas-fir Select, Board, and Dimension grade lumber

Lumber grade	Thickness	Width (inches)				
		4	6	8	10	12+
---Inches--- ---Dollars per thousand board feet---						
SELECTS:						
B and Better	1	165	165	175	175	225
	2	135	145	165	185	225
	3 and 4	175	190	190	190	245
	5+	--	205	205	205	265
C	1	130	135	135	145	195
	2	120	125	125	135	185
	3 and 4	155	170	170	170	220
	5+	--	185	185	185	235
D	1	85	100	100	105	135
	2	80	95	95	95	125
	3 and 4	125	140	140	140	190
	5+	--	155	155	155	205
BOARDS AND DIMENSION:						
Select Structural ^{1/}	1	76	76	80	85	90
	2	81	81	86	92	92
	3 and 4	98	98	98	98	113
	5+	--	98	98	98	113
Construction	1	69	69	69	71	71
	2	74	74	74	78	78
	3 and 4	85	85	85	85	90
	5+	85	85	85	85	90
Standard	1	48	48	46	46	46
	2	63	61	60	58	58
	3 and 4	75	75	75	75	80
	5+	--	75	75	75	80
Utility	1	36	36	36	36	36
	2	45	42	38	34	34
	3 and 4	50	50	50	50	50
	5+	--	50	50	50	50
Economy	1	17	17	17	17	17
	2	18	18	17	17	17
	3 and 4	20	20	20	20	20
	5+	--	20	20	20	20

^{1/} Grade name for boards is Select Merchantable.

**Table 3.—Representative 1963 prices for coast Douglas-fir
Shop and Moulding grade lumber**

Lumber grade	Thickness (inches)	
	1	5/4 and thicker
-----Dollars per thousand board feet-----		
SHOP:		
Factory Select ^{1/}	115	105
No. 1 Shop	95	90
No. 2 Shop	65	60
No. 3 Shop	35	30
MOULDING:	80	125

^{1/} For 1-inch Shop, grade name is Select Shop.

**Table 4.—Representative 1965 veneer prices for
coast Douglas-fir**

Veneer grade	Dollars per thousand square feet, 3/8-inch basis ^{1/}
A	80.68
B	48.05
C	21.72
D	17.18

^{1/} Prices are "pond-values" for dry, untrimmed veneer; i.e., the estimated value of veneer in the log at the mill but prior to peeling.

Lane, Paul H., Richard O. Woodfin, Jr., John W. Henley,
and Marlin E. Plank
1973. New timber cruising grades for coast Douglas-fir.
USDA Forest Serv. Res. Pap. PNW-151, 12 p.,
illus. Pacific Northwest Forest and Range Experi-
ment Station, Portland, Oregon.

New log grades for cruising coast Douglas-fir have been
developed and tested. They are for application to standing
timber and provide an accurate estimate of lumber and veneer
yields and timber values.

KEYWORDS: Log grade, timber cruising, forest
appraisal, coast Douglas-fir,
Pseudotsuga menziesii, lumber
yield, veneer yield.

Lane, Paul H., Richard O. Woodfin, Jr., John W. Henley,
and Marlin E. Plank
1973. New timber cruising grades for coast Douglas-fir.
USDA Forest Serv. Res. Pap. PNW-151, 12 p.,
illus. Pacific Northwest Forest and Range Experi-
ment Station, Portland, Oregon.

New log grades for cruising coast Douglas-fir have been
developed and tested. They are for application to standing
timber and provide an accurate estimate of lumber and veneer
yields and timber values.

KEYWORDS: Log grade, timber cruising, forest
appraisal, coast Douglas-fir,
Pseudotsuga menziesii, lumber
yield, veneer yield.

Lane, Paul H., Richard O. Woodfin, Jr., John W. Henley,
and Marlin E. Plank

1973. New timber cruising grades for coast Douglas-fir.
USDA Forest Serv. Res. Pap. PNW-151, 12 p.,
illus. Pacific Northwest Forest and Range Experi-
ment Station, Portland, Oregon.

New log grades for cruising coast Douglas-fir have been
developed and tested. They are for application to standing
timber and provide an accurate estimate of lumber and veneer
yields and timber values.

KEYWORDS: Log grade, timber cruising, forest
appraisal, coast Douglas-fir,
Pseudotsuga menziesii, lumber
yield, veneer yield.

Lane, Paul H., Richard O. Woodfin, Jr., John W. Henley,
and Marlin E. Plank
1973. New timber cruising grades for coast Douglas-fir.
USDA Forest Serv. Res. Pap. PNW-151, 12 p.,
illus. Pacific Northwest Forest and Range Experi-
ment Station, Portland, Oregon.

New log grades for cruising coast Douglas-fir have been
developed and tested. They are for application to standing
timber and provide an accurate estimate of lumber and veneer
yields and timber values.

KEYWORDS: Log grade, timber cruising, forest
appraisal, coast Douglas-fir,
Pseudotsuga menziesii, lumber
yield, veneer yield.



The mission of the PACIFIC NORTHWEST FOREST AND RANGE EXPERIMENT STATION is to provide the knowledge, technology, and alternatives for present and future protection, management, and use of forest, range, and related environments.

Within this overall mission, the Station conducts and stimulates research to facilitate and to accelerate progress toward the following goals:

1. Providing safe and efficient technology for inventory, protection, and use of resources.
2. Development and evaluation of alternative methods and levels of resource management.
3. Achievement of optimum sustained resource productivity consistent with maintaining a high quality forest environment.

The area of research encompasses Oregon, Washington, Alaska, and, in some cases, California, Hawaii, the Western States, and the Nation. Results of the research will be made available promptly. Project headquarters are at:

Fairbanks, Alaska	Portland, Oregon
Juneau, Alaska	Olympia, Washington
Bend, Oregon	Seattle, Washington
Corvallis, Oregon	Wenatchee, Washington
La Grande, Oregon	

The FOREST SERVICE of the U. S. Department of Agriculture is dedicated to the principle of multiple use management of the Nation's forest resources for sustained yields of wood, water, forage, wildlife, and recreation. Through forestry research, cooperation with the States and private forest owners, and management of the National Forests and National Grasslands, it strives — as directed by Congress — to provide increasingly greater service to a growing Nation.